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MECHANICAL PROPERTIES AND ORGANIC COMPOSITION OF PROCESSED AND IRRADIATED HUMAN CORTICAL BONE ALLOGRAFT

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SUMMARY

Processing and radiation appeared to influence mechanical properties of cortical bones partly due to denaturation of collagen composition in bone. Femurs harvested from four cadaveric donors, initially tested negative for serology tests, were cut and cortical bones were processed as frozen, freeze-dried or demineralized, followed by gamma irradiation at 5, 15, 20, 25 and 50 kGy. In the compression test, freeze drying significantly decreased the stiffness (W/**δ)** of the cortical bone by 15% ($p < 0.05$) and demineralisation process further reduced significantly by 90% ($p < 0.05$). The ultimate strength (W_{max}) of demineralised bone was significantly reduced by 93%. In the bending test, both processes significantly reduced the ultimate strength and the work to failure. Effects of radiation on mechanical properties were not dose dependent. At 50 kGy, the bending ultimate strength significantly reduced by 27% and 47% in the frozen and demineralised bone, respectively but not in the freeze dried (24%, $p > 0.05$). The demineralised bone showed the highest peak of the amide I collagen in the FTIR spectra indicating more collagen was exposed after the calcium was removed, however radiation did not affect the collagen crosslink. In conclusion, freeze drying and demineralization weakened the mechanical resistance of the cortical bone by losing its capacity to absorb energy. The ability to resist deformation in response to an applied force was clearly influenced by the processing methods. No radiation dose related effect on mechanical properties was observed. Significant reduction in ultimate strength was only detected at 50 kGy. Therefore, commonly used sterilization dose of 25 kGy does not affect mechanical properties and collagen composition of the cortical bone.